

ATTORNEY'S DOCKET NO: 82295

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U.S. DEPARTMENT OF COMMERCE, PATENT AND TRADEMARK OFFICE		DATE: <u>24</u> April 2001 (<u>24</u> .04.2001)
TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371		U.S. PAT. NO. <u>656116</u> Not Yet Assigned
INTERNATIONAL APPLICATION NO.: PCT/CN99/00061	INTERNATIONAL FILING DATE: 26 April 1999 (26.04.99)	PRIORITY DATE CLAIMED: N/A
TITLE OF INVENTION: IMPROVED HAMMER FOR A PIEZOELECTRIC ACTUATOR AND METHOD FOR PRODUCING SAME		
APPLICANT(S) FOR DO/EO/US: SHER, Tak Chi		
Applicant hereby submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:		
<p>1. <input checked="" type="checkbox"/> This is a FIRST submission of items concerning a filing under 35 U.S.C. 371.</p> <p>2. <input type="checkbox"/> This is a SECOND or SUBSEQUENT submission of items concerning a filing under 35 U.S.C. 371.</p> <p>3. <input checked="" type="checkbox"/> This express request to begin national examination procedures (35 USC 371(f)) The submission must include items(5), (6), (9) and (21) indicated below.</p> <p>4. <input checked="" type="checkbox"/> A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.</p> <p>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2)):</p> <p style="margin-left: 40px;">a. <input checked="" type="checkbox"/> is transmitted herewith (required only if not transmitted by the International Bureau).</p> <p style="margin-left: 40px;">b. <input type="checkbox"/> has been communicated by the International Bureau.</p> <p style="margin-left: 40px;">c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US)</p> <p>6. <input type="checkbox"/> A English translation of the International Application as filed (35 U.S.C. 371(c)(2)).</p> <p>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))</p> <p style="margin-left: 40px;">a. <input type="checkbox"/> are attached hereto (required only if not transmitted by the International Bureau).</p> <p style="margin-left: 40px;">b. <input type="checkbox"/> have been communicated by the International Bureau.</p> <p style="margin-left: 40px;">c. <input type="checkbox"/> have not been made; however, the time limit for making such amendments has NOT expired.</p> <p style="margin-left: 40px;">d. <input checked="" type="checkbox"/> have not been made and will not be made.</p> <p>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</p> <p>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</p> <p>10. <input type="checkbox"/> A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</p> <p>ITEMS 11 to 20 BELOW CONCERN OTHER DOCUMENT(S) OR INFORMATION INCLUDED:</p> <p>11. <input type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</p> <p>12. <input checked="" type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</p> <p>13. <input type="checkbox"/> A FIRST preliminary amendment.</p> <p>14. <input type="checkbox"/> A SECOND or SUBSEQUENT preliminary amendment</p> <p>15. <input type="checkbox"/> A substitute specification.</p> <p>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</p> <p>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter2 and 35 USC 1821 - 1825</p> <p>18. <input type="checkbox"/> A second copy of the published international application under 35 USC 154(d)(4)</p> <p>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 USC 154(d)(4)</p> <p>20. <input checked="" type="checkbox"/> Other items or information:</p> <p>TRANSMITTAL FORM; FEE CALCULATION; INTERNATIONAL PUBLICATION WO 00/65668; INTERNATIONAL PUBLICATION DATE 02 NOVEMBER 2000; CONSISTING OF 9 PAGES INCLUDING; 1 COVER SHEET CONTAINING THE ABSTRACT, 4 PAGES TEXTUAL SPECIFICATION, 2 PAGES OF 8 CLAIMS; 2 SHEETS DRAWINGS; PCT/ISA/210 INTERNATIONAL SEARCH REPORT; EXECUTED INVENTOR'S DECLARATION; ASSIGNMENT AND RECORDATION COVER SHEET; VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS; PCT/IPEA/416 NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT; PCT/IPEA 409 INTERNATIONAL PRELIMINARY EXAMINATION REPORT; PCT/IPEA/401 DEMAND; PCT/RO/101 REQUEST.</p>		

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IMPROVED HAMMER FOR A PIEZOELECTRIC ACTUATOR
AND METHOD FOR PRODUCING SAME

BACKGROUND OF THE INVENTION

The present invention relates to a unique hammer used in piezoelectric actuators. Specifically the present invention provides a hammer body with integral outwardly extending hammer arms and a method for producing the same.

Existing hammers as used in piezoelectric actuators are composed of two separate component parts--a hammer body and a hammer pin. To date there has not been a hammer in one unit, i.e., the hammer body and pin molded together, by die cast molding, nor has there been a hammer with a hole through the hammer body by die cast molding. The technical problems of molding such a small piece have not been overcome.

Presently, assembly of the hammer pin into the hammer body necessitates drilling a hole through the hammer body. The drilling of such a small hole through the hammer body which is also miniature in size is very difficult. For best performance of the hammer, the hammer pin must be fixed at the center point of the hammer body and in an absolutely balanced, horizontal and symmetric manner. This is very difficult to achieve for technical reasons during assembly of the hammer pin into the hammer body.

In the present invention, the hammer still consists of 2 parts. Yet, it is not necessary to drill a hole through the hammer body. Furthermore, the center point of the hammer body and the balance, horizontality and symmetricalness of the hammer arms is guaranteed in the

process of the present invention. The performance of the finished product using this newly invented hammer is therefore enhanced.

SUMMARY OF THE INVENTION

The present invention is a two-part hammer for a piezoelectric actuator wherein the horizontal hammer arms are integrally molded into the hammer ring member. A hammer body member having a vertically extending axle supports and retains the ring member by extending through a central opening in the ring.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a cross-sectional view of a prior art hammer within a piezoelectric actuator.

Fig. 2A illustrates an exploded perspective view of a first prior art hammer.

Fig. 2B shows a side elevation view of the first prior art hammer of Fig. 2A.

Fig. 2C illustrates an exploded perspective view of a second prior art hammer.

Fig. 2D shows a side elevation view of the second prior art hammer of Fig. 2C.

Fig. 3A illustrates an exploded perspective view of the hammer of the present invention.

Fig. 3B shows a side elevation view of the hammer of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 illustrates in a cross-sectional view of a prior art hammer 11A within a piezoelectric actuator. The operation of such devices is well known in the art. The actuator operates by the collision of the hammer 11A with other parts of the actuator to generate an

electric charge. Any deviation in the balanced, symmetrical construction of the hammer 11A will affect the stability of the emission of the electric charge from the actuator.

Figs. 2A-2D also illustrate prior art hammers. Fig. 2A is an exploded view of the two-part hammer 11. It has a hammer body member 12 and a hammer pin 14. A hole 16 must be drilled through the body 12 to accept the pin 14. The drilling is done after the body has been molded. Pin end 18 is pressed into the hole 16 and must be exactly in the center of the body 12 to be absolutely balanced and horizontal with the extended arms 22 and 24 perfectly symmetrical.

Another prior art hammer 11A is shown in Figs. 2C and 2D. Again, pin 14A must be pressed into drilled hole 16A with the arms 22A and 24 perfectly symmetrical, balanced, and horizontal within the body 12A.

The present invention is shown in Figs. 3A and 3B. Hammer 11C has a guaranteed center point with perfect balance, horizontal arms, and symmetric arms because the arms 22C and 24C are formed by unitary molding. The arms are formed in the molding process and are, therefore, integral to the ring body 30. The hammer arms are not formed by a pin passing through a delicately drilled hole as is known in the prior art. Hammer ring body 30, made of metallic or non-metallic materials, such as plastic, is a generally cylindrical tube with a vertically extending, central opening 34 with perpendicularly extending arms 22C and 24C. By forming the arms in the mold improved symmetry and balance of the hammer is achieved.

The hammer 11C is assembled by placing ring 30 over hammer body member 40, which is made of metal. Hammer body member 40 has a cylindrical base portion 42 with

a shoulder 44. Extending upwardly from the center of the base portion 42 is an elongated cylindrical axle member 46. When assembled, the underside 36 of the ring 30 is pressed against the shoulder 44 of the body member 40.

The outer surface 48 of the elongated axle 46 may be fixed or fitted tightly against the inner surface 38 of the ring 30 by various means. Depending upon the composition of the ring 30, there may be a certain degree of elasticity of ring 30, the diameter of the inner hole 34, thus, may be slightly less than the diameter of the elongated axle 46 (the axle having a diameter the same as or slightly greater than the hole). Alternatively, the inner surface 38 may be provided with protruding vertical strips 50 which when the ring 30 is wholly squeezed onto the elongated axle 46 will fit tightly against the inner surface 38 and the strips 50 to hold the ring 30 on the body member 40. Thus, an improved hammer is produced.

Although the invention has been described with reference to a specific embodiment, this description is not meant to be construed in a limiting sense. On the contrary, various modifications of the disclosed embodiments will become apparent to those skilled in the art upon reference to the description of the invention. It is therefore contemplated that the appended claims will cover such modifications, alternatives, and equivalents that fall within the true spirit and scope of the invention.

CLAIMS:

1. A hammer for a piezoelectric actuator comprising:
 - a hammer ring member having two perpendicularly extending integral arms and a central opening; and
 - a hammer body having a base portion and an upwardly extending axle member, said axle member extending through said central opening of said hammer ring, said hammer ring member seated on said base portion of said hammer body.
2. The hammer of claim 1 wherein said axle member is generally cylindrical having a diameter slightly less than said central opening to ensure a tight fit between said axle member and said central opening.
3. The hammer of claim 1 wherein said central opening has protruding vertical strips for urging against an outer surface of said axle member to ensure a tight fit between said axle member and said central opening.
4. The hammer of claim 3 wherein said axle member is generally cylindrical.
5. The hammer of claim 1 wherein said ring member is made of molded plastic and said hammer body is made of metal.

6. The hammer of claim 5 wherein a diameter of said central opening of said hammer ring is same as or slightly less than a diameter of said axle member.
7. A method for producing a hammer for a piezoelectric actuator comprising the steps of:
- molding a unitary hammer ring member having two perpendicularly extending integral arms and a central vertical opening;
 - molding a hammer body having a base portion and an upwardly extending axle member;
 - pressing said unitary ring onto said hammer body with said axle member extending through said central opening and said ring seated on said base portion.
8. The method of claim 6 wherein said hammer ring member is made of plastic material and said hammer body is made of metal materials.

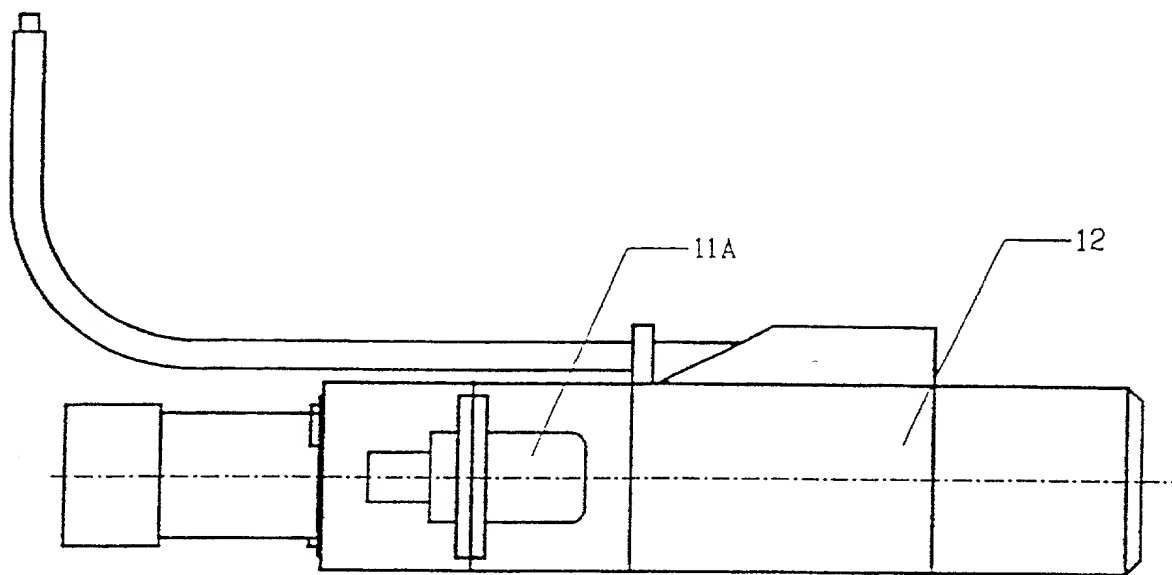


Fig. 1

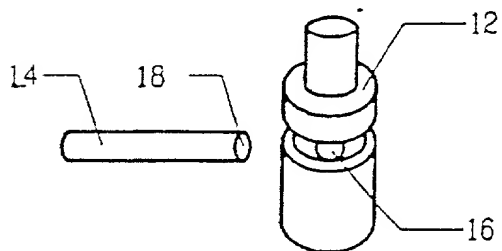


Fig. 2A

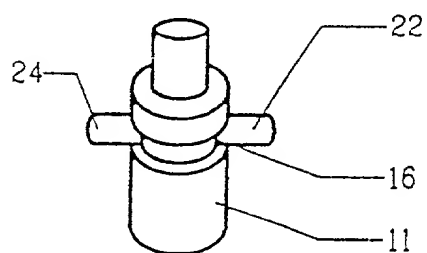


Fig. 2B

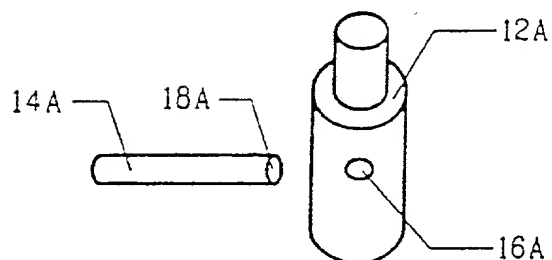


Fig. 2C

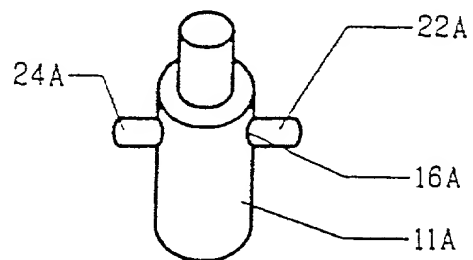


Fig. 2D

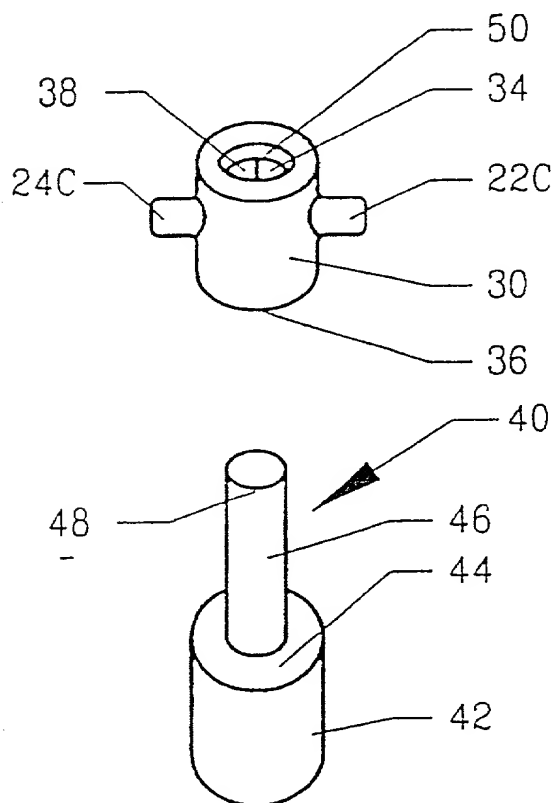


Fig. 3A

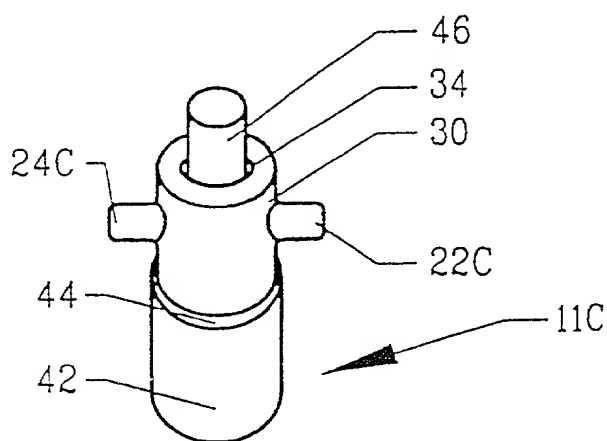


Fig. 3B

USA

DECLARATION FOR PATENT APPLICATION

Atty Docket 82295

As the below-named inventor/inventors, I/we hereby declare that:

My/Our residences, post office addresses and citizenships is/are as stated below next to my/our name/names.

I/We believe I/we am/are the original, first and sole inventor (if only one name is listed below) or the original, first and joint inventors (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Improved Hammer for a Piezoelectric Actuator and Method for Producing Same

the specification of which is attached hereto unless the following is checked:

☒ was filed on 26 April 1999, as Serial No. PCT/CN99/00061

and was amended on _____ (if applicable).

I/we hereby state that I/we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I/we acknowledge the duty to disclose information which is material to the patentability of this application in accordance with 37 CFR ' 1.56.

I/we hereby claim foreign priority benefits under 35 U.S.C. ' 119 (a) - (d) or '365(b) of any foreign application(s) for patent or inventor's certificate or '365a of any PCT international application which designates at least one country other than the United States, listed below, and have also identified below any foreign application for patent or inventor's certificate, or PCT international application, having a filing date before that of the application on which priority is claimed:

Prior Foreign Applications:

Priority
Not Claimed
☐

(Application No.) (Country) Day/Month/Year Filed

(Application No.) (Country) (Day/Month/Year Filed)

I/we hereby appoint Gary M. Nath, Reg. No. 26,965; Harold L. Novick, Reg. No. 26,011; Todd L. Juneau, Reg. No. 40,669; Lee Heiman, Reg. No. 41,827; David R. Murphy, Reg. No. 22,751; Jerald L. Meyer, Reg. No. 41,194; Joshua B. Goldberg, Reg. No. 44,126; Paul A. Sacher, Reg. No. 43,418; Nahied K. Usman, Reg. No. 47,148; Marvin C. Berkowitz, P-47,421; and Roger Hahn, Reg. No. 46,376; as my/our attorneys to prosecute this application and transact all business in the U.S. Patent and Trademark Office connected therewith.

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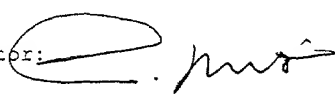
I/we hereby claim the benefit under 35 U.S.C. ' 120 of any United States application(s), or '365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application or PCT international application in the manner provided by 35 U.S.C. ' 112, first paragraph. I/we acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR ' 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(U.S. Appln Serial No.) (U.S. Filing Date) (Status--patented, pending, abandoned)

(U.S. Appln Serial No.) (U.S. Filing Date) (Status--patented, pending, abandoned)

Atty Docket 82295

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. ' 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: 1-00 

Inventor's Signature _____

Date 9th April 2001

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Date 9th April 2001

Residence:

Citizenship:

Post Office Address:

Full name of third inventor:

Inventor's Signature _____

Date 9th April 2001

Residence:

Citizenship:

Post Office Address: